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CENTRAL INTELLIGENCE AGENCY

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SECURITY INFORMATION

INFORMATION REPORT

REPORT [redacted]

CD NO.

COUNTRY USSR (Moscow and Kalinin Oblasts)

DATE DISTR. 6 February 1953

25X1 SUBJECT [redacted]

25X1 [redacted] Zavod 88 on Gorodomlya Island

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25X1 DATE OF INFO. [redacted]

NO. OF ENCLS. (LISTED BELOW) [redacted]

25X1 PLACE ACQUIRED [redacted]

SUPPLEMENT TO REPORT NO. [redacted]

[redacted]

THIS IS UNEVALUATED INFORMATION

[redacted]

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Organization

1. The development and production of the A-4 was begun after the end of the war by the Ministry for Armaments at Zavod 88, Moscow-Kaliningrad, USSR. [redacted] [redacted] the space used for this work in Zavod 88 was only rented. Working and laboratory space [redacted] [redacted] was provided first in the construction office and later in a wing of the main building.

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[redacted]

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2. Branch No. 1 of Zavod 88 was located on Gorodomlya Island, near Ostashkov, and was subordinate to Zavod 88. Engineers of the plant frequently visited the branch [redacted] About 500 Soviets were employed on the island, of which about 60 were in the institute.[1] Some of them lived in Ostashkov. [redacted]

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3. [redacted]

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4. During the period from January to June 1947, the radar train brought to Zavod 88 [redacted] was put into operation. [redacted]

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5. The control engineers started their work with the available Markgraf gyroscope. With this gyroscope it is possible to obtain a control pulse of $s = a\varepsilon + b\varepsilon$, where ε is the torsion around the axis in question. [redacted]

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6. The starting point for the laboratory work of the high-frequency engineers was an "Emil" component [redacted] which was found among the captured material stored in the factory. This apparatus was used for the development of a radio control. In particular, a method was to be developed for measuring velocity, utilizing the pulses used for range determination.

7. The quartz frequency of the "Emil" apparatus, after multiplication, was used for the modulation of the ground pulse transmitter. The pulses were received on the airborne apparatus [redacted] and were radiated back on the same frequency. Then the velocity was determined on the ground from the Doppler frequency. Later, the American SCR-584 radar was used as a ground transmitter. [redacted] the Soviets [redacted] were encountering great difficulties.

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8. Bugayev, the director of this development project, was relieved in October 1949. At the same time Sergeyev, the director of the radio group, went to a Moscow testing laboratory, where he had previously worked. [redacted] the failure of their development projects was the reason for their release.

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9. The only thing known in Ostashkov about the work performed by the radio laboratories of the factory in 1950 and 1951 is that much work was done with the SCR-584 radar and with the reproduction of the American apparatus.

10. The following additional projects were carried out by the high-frequency group so that the requirements were fulfilled to a certain extent:

a. Tests of antennas on an A-4 model of a scale of 1:10. Doorframe, split, and rod antennas with a wave length of 50 centimeters were tested. A 6J6

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served as a transmitter tube.

b. Generator for a continuously detunable quartz-controlled standard frequency of 400-500 Hertz units.

c. Construction of an RC generator for exact sinusoidal oscillations in the range of 0.01 - 50 Hertz units. Even at the second derivation of the oscillations, no deviation from the sine curve was noticeable. The apparatus was to replace the previously used potentiometer transmitter.

25X1 Work of [redacted] Branch 1 of Zavod 88 on Gorodomlya Island

11. Branch 1 of Zavod 88 had the general task of continuing the development of the A-4 and similar rockets. [redacted] The propulsion, ballistics, and aerodynamics groups were engaged in plans for various projects until the beginning of 1950; this was purely desk work. A proposal which formed the basis of many plans was the construction of the outer skin as a supporting structural part. This proposal was at first designated as G-1. There was also an important plan [redacted] which provided for propulsion of the turbine by gas taken from the combustion chamber.

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12. The following plans involved a rocket with a range of 3,000 kilometers:

a. Plan for a rocket in the shape of a slender cone with a combustion chamber for 60 atmospheres absolute pressure and a two-stage pump. The plan was designated R-14; possibly it was also conducted at first under G-4. Launching stands and bunkers were designed for this project [redacted]

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b. Plan for a rocket with conical body and several standard combustion chambers.

c. Plan for a combination of several standard A-4's in order to obtain take-off assistance.

d. Plan for a special vertical combustion chamber, which would work at a normal pressure of 15 atmospheres absolute pressure with a longer nozzle.

13. The following plans were also worked on:

a. Plans for swiveling combustion chambers to replace the rudders; plans for combustion chambers for 15 and 60 atmospheres absolute pressure. Much work was spent on these plans.

b. Plan for swiveling nozzles for control. The designations R-9, R-10, and R-11, among others, were used for these plans.

c. The airfoil wing plan [redacted] bore the designation R-15 [redacted] The body, which was to have a range of 6,000 - 10,000 kilometers, was designed as a supersonic aircraft, and was to contain a self-compressing jet propulsion system (ram compressor). An A-4 component without head was provided for as take-off assistance.[3]

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d. The Soviets [redacted] planned a rocket shaped like the A-4 but somewhat longer and with a pressure-resistant steel body. [redacted] Umanskiy later conducted experiments in connection with this plan.

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14. The plans prepared for Project G-1 were presented at a section conference which was held 19 - 30 December 1948 in the large lecture hall of the main building of Zavod 88. Diagrams, charts, and specifications had to be submitted in advance. 25X1 [redacted] 50 Soviets, about half of whom were assigned to Zavod 88. In discussing the presentations, the Soviets tried, through criticism, to find the weak points of the project. The data were sent back to Branch 1; during the next six months a few additional individual inquiries concerning the presentations were made. After that, the Soviets never brought up the matter again.

15. At the end of 1949 and the beginning of 1950 a similar conference was held in Zavod 88 in connection with Project R-14; however, the data were retained by the Soviet members of the Branch.

16. In spring 1950 the "AA rocket" project was begun. According to the plan, the project was to be terminated in fall 1950; however, it continued until spring 1951. At Soviet instigation, the Wasserfall rocket was made the basis of the development. A proposal to work with smaller and cheaper bodies of about 500 kilograms and to put several of them on the same beam according to the line-of-sight system was rejected 25X1 [redacted] 25X1 It was decided to develop a Wasserfall rocket with two wings. The rocket was to be kept on a beam by elevator control and spin stabilization, while the target was held by a DF beam. The computer was to be developed 25X1 [redacted] and was to work with integrating rollers which rolled on a ball. The most difficult problem was the correct combination of the spin stabilization with the elevator control. In case of a deviation from the beam, the rocket was at first to be rotated around its longitudinal axis so that the perpendicular to the surface of the wings would point toward the beam. Only then would the elevator control take effect and direct the rocket again onto the beam. 25X1 25X1 25X1 [redacted] However, the developmental work proved that the difficulties had been underestimated. After [redacted] 1951, it became clear to the Soviets that the control problems were too difficult, and the project was terminated with a report.

17. A wind tunnel, which worked with compressed air at 150 atmospheres, was put into operation for Sector 2 in spring 1950. The diameter of the nozzles was 20-70 millimeters; the highest attainable Mach number was 3 to 4. A hydrodynamic tank about four meters long and one meter wide was also at hand.

18. A combustion test stand, the completion of which was planned for February 1949, was put into operation at the end of 1949. It was designed for the thrust of a standard combustion chamber of the Wasserfall rocket. An alcohol-oxygen mixture was worked with chiefly, as well as a petroleum-alcohol mixture. Nitric acid was not used because of the poisonous exhaust gases, and H_2O_2 was not used because of the danger of explosion. 25X1 [redacted] 25X1 Much work was done on the problem of carbonization.[4]

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19. In the electronics sector until winter 1948-49, individual projects which were already proceeding in Zavod 88 were continued in small individual groups. From the beginning of 1949, the following aspects of radio control were worked on in the following individual groups:

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a. Velocity measurements (low-frequency part) [redacted]

b. Range finder -

c. Airborne equipment -

d. Ground equipment in general and a new project for velocity measurement [redacted]

In summer 1949 the three groups, controls and trajectory model, radio control, and measuring equipment, were formed into Sector 4.

20. The experiments with the Markgraf gyroscope, which were begun in Moscow, were continued by the controls group. In order to laboratory test the characteristics of control equipment, it is necessary to have an apparatus which artificially reproduces the characteristics of the rocket. This device was called a trajectory model. At first the only trajectory model available was an old German one from Bleicherode. This trajectory model, with which the control characteristics for one axis of the rocket could be represented, was further developed. It was the size of a desk. Three of these trajectory models were built by order of Zavod 88. A three-axis trajectory model was also built, with which the control characteristics around the three axes of the rockets could be represented simultaneously in regard to their mutual combination. This apparatus is supposed to have been working properly in the laboratory [redacted] however, [redacted] it questionable whether the Soviets are able to service it properly. An additional five to six complete control apparatuses with Markgraf gyroscopes were built by the group.

21. The mathematical representation of the control problem was worked out [redacted] The required calculation processes were carried out in the trajectory model by the integration equipment and the so-called coefficient indicator, with which the fixed and variable characteristics of the rocket (mass, thrust, and velocity) were introduced into the calculation. The progress of the magnitudes calculated by the trajectory model could be registered with a loop oscillograph. When the same control process was gone through several times on the trajectory model, the dispersion of the values calculated amounted to five to ten percent at the most.

22. A new servo-motor was developed [redacted] It was to work purely pneumatically or possibly also hydraulically. This would enable them to dispense with the electric powering of the servo-motor of Askania and Siemens. Several parts of this servo-motor were delivered to Zavod 88, where they were to be reproduced. [redacted] the Markgraf gyroscope, the Askania servo-motor, and the Askania servo-motor magnet were reproduced at Zavod 88.

23. In summer 1949 the newly formed radio control group, together with the leaders of the branch, was assigned the task of developing a radio control for the A-4, in which the trajectory elements of the rocket were to be determined to the following exactness: control accuracy: azimuth $\pm$ 3', elevation 0.3°, velocity $\pm 10^{-4}$, and range $\pm$ 100 meters.

24. At the beginning of 1950 the order for the development of this new apparatus was officially given from Moscow. The following apparatuses for this radio control system had been developed as of May 1951:

a. A DF antenna system. This consisted of four parabolic reflectors of three meters diameter. The vertical distance of the reflectors was three meters; the horizontal distance, 17 meters. The wave length was 50 centimeters; the dipoles were mounted horizontally. The reflectors were individually mounted and rotated around electrohydraulically coupled horizontal axes. The DF accuracy was measured on a dipole attached to a 28-meter-high mast and later checked during experimental flights with a recording theodolite. In both cases, a DF accuracy of 0.5' in azimuth and 0.05° in elevation was achieved. This accuracy corresponded to the requirements, which were ascertained with the aid of the trajectory model. For a stable operation of the control system, the DF accuracy had to be at least one-sixth of the control accuracy.

b. Apparatus for transmitting signals. For transmitting signals, one low frequency each of the 50-centimeter wave was modulated upon for control according to azimuth and elevation. The low frequencies were changed continuously in proportion to the magnitude of the steering signals.

c. An apparatus for measuring velocity (V). The 50-centimeter wave continuously radiated from the ground was transformed on the airborne apparatus to an only slightly divergent frequency and radiated back. A beat frequency of $f = 6 \text{ fo } \frac{V}{c}$ was obtained on the ground apparatus from the wave radiated back and the wave received directly ($fo = 6 \cdot 10^8$ Hertz units). The velocity measurement served to determine the combustion cut-off of the rocket. A time of ten ms was available for the entire cut-off process, if the required range was to be kept to an accuracy of about 300 meters. Only one to two ms of this time were used for the measurement; the rest was needed for the actuation of the cut-off apparatus.

d. Apparatus for measuring distance. To determine the distance, pulses with a pulse frequency of 12 kilocycles per second were superimposed on the continuously radiating ground transmitter. The indication of the distance was to take place electrically through a multivibrator connection, which produced in a known manner a voltage proportional to the time difference between the transmitted pulse and the received pulse. Experience showed that the received pulse could not be well distinguished from the noise level. Much further development work would have been necessary for a reliable design for this method of measurement. [redacted] more advisable, instead of this, to work with the usual indication of the pulse on a cathode ray tube. The result of the distance measurement was to be adjusted through a correction of the cut-off velocity set in the cut-off apparatus.

e. The ground transmitter had a capacity of 60 to 80 watts; its frequency was quartz-controlled. The airborne transmitter had a capacity of five watts. For the transmitting and receiving antennas of the airborne apparatus, dipoles with reflectors were to be installed in place of the Messina antennas on opposed stabilizing surfaces of the A-4. These were built but they were never tested on the model.

25. In summer 1949 a model apparatus working according to this method, with a longer wave length, was tested in an aircraft. In spite of the poor results of this experiment, the development was continued. The fundamental development work was carried out during the period from May 1950 to May 1951; it led to the construction of the apparatus described. The ground equipment was installed in a motor vehicle. A loop oscillograph with eight loops and four time-recording apparatus indicators was available for recording the test data. A Soviet group under the direction of Fomin appeared in May 1951; this group was to learn how to use the equipment and take it over. [redacted] this group came from Bolshevo. During the transfer of the equipment to the Soviets, flight tests were made, in which the airborne apparatus was installed in a twin-engine aircraft. The equipment was sufficient for the stipulated requirements. Satisfactory beam flights, on the basis of signals transmitted from the ground, were possible through the instruction of the aircraft pilot. During a curvilinear flight an oscillogram could be obtained with the velocity measuring equipment in which the beat frequency proportional to the range correction dropped uniformly to zero and then rose again. In October the equipment was finally handed over to the Soviets. [redacted] this was a laboratory model which was capable of development and ready for operation.

26. During the development, the equipment was examined several times by Konoplov. [redacted] Konoplov, who allegedly was in charge of a group for radio control in Leningrad, was looking for defects in the equipment for reasons of competition. For example, he expressed doubt as to the

DF accuracy, because the dipoles shook, without considering that the small oscillations of the dipole would have no influence on the large DF base. He also declared that the hot combustion gases would absorb the 50-centimeter wave; he had had experiences in that. From conversations of other Soviets, however, it was learned that Konoplov had worked with a ring-shaped split antenna attached to the nose of the A-4, from which, merely according to the geometry of the construction, a poor radiation backwards is to be expected. The question was frequently discussed at meetings as to why, during reception from the Messina transmitter, the sound level was diminished by the factor
25X1 three to four after the combustion cut-off. [redacted] it was not a question of reflection and absorption by the flash but of a detuning of the antenna by the changed dielectric constant.

27. At a meeting which took place in Moscow after the transfer of the equipment, Chertok is said to have stated that it would be better to have this equipment than none.

28. Only individual apparatuses were developed by the radio control group after October 1951. Projects were assigned from Moscow. The projects all had deadlines, which were observed, but without regard to the quality of the work. The following apparatuses were developed:

a. An apparatus for plotting the characteristic of antennas mounted on a rotary disk 30 centimeters in diameter. During the tests it was determined that a larger disk, suitable for heavier apparatuses, was needed.

b. A quartz controlled frequency generator for the production of discrete frequencies adjustable by a switch. An accuracy of 10^{-9} was demanded; one of 10^{-7} was achieved.

c. A quartz gauge with time signal receiver.

d. Two sine indicators.

e. An eight-fold oscillograph with indication on a cathode ray tube and film recording.

29. The testing equipment group built, repaired, and calibrated the electrical and mechanical testing equipment needed in the institute. Even Zavod 88 occasionally brought instruments in for calibration. Pressure pickups and thermocouple elements were built mainly. A gyroscopic balancing device was produced. A three- and six-component scale was developed by Dr. Rudolf Coermann. The measurement indicators were a further development of the old Messina pressure boxes and worked on the inductive principle with a test section of about 10 μ. At 500 Hertz units they delivered an output voltage of 50 .... 500 millivolts. Until winter 1948/1949, work was done on indicators for the Messina apparatus for transmitting acceleration and vibration values. Then work on the Messina apparatus was completely suspended.

30. Sector 7 had its own small combustion test stand [redacted]
25X1 [redacted] on fuels charged with metal colloids.

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Firing Range for A-4

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31. [redacted] firing tests [redacted] were held in fall 1947 in Kapustin Yar. Eight A-4 rockets were fired. In the case of the first four, the control mechanisms failed after 35 seconds. An analysis of the
25X1 oscillograms revealed that the trouble had been caused by too small a time constant for the controls [redacted] eliminated this defect by enlarging the time constant of the controls by installing a condenser in the control amplifier. The controls worked satisfactorily

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thereafter on the last four rockets. [redacted]

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32. [redacted] the firing tests were held regularly during the period from August to December. For example, Dronovskiy, who frequently travelled to Kapustin Yar for about two weeks, was always absent for a longer time in the fall. He would then return to the Branch around Christmas time. [redacted] Dronovskiy wanted to transfer model tests to a large combustion chamber in Kapustin Yar, with the turbine to be powered by gas taken from the combustion chamber.

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33. The Soviets from Zavod 88 and Branch 1 never expressed themselves about positive results obtained at Kapustin Yar. [redacted] the rocket experimentation by Zavod 88 had been unfavorably criticized by the Ministry for Armaments. Even Fomin, who took over the radio controls [redacted] was very skeptical of the work done by Zavod 88. He himself was compelled to find a less responsible job in television or in the testing instrument industry.

Miscellaneous

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34. [redacted]

35. In winter 1949/1950 the Branch received the first Soviet reproductions of the LD6, LD7, LD9, LD10, LD11, and LD12 tubes. In the first shipments, the tube numbers were marked in ink. The soldered joints were additionally provided with a layer of varnish. The quality of the tubes delivered improved steadily and was good in 1951. The tubes were provided with serial numbers. At the same time various high-frequency testing equipment came from Gorkiy (56-20N, 44-00E), including a GSS test oscillator and a tube voltmeter, to which a label in the German language was attached. The trademark of this apparatus showed a lighthouse with two cones of rays. Recently, newly developed test oscillators for 50 - 250 thousand Hertz units were delivered from the Orion firm in Budapest. German circuit diagrams and German labels were used in the apparatuses from the Orion firm. Gas-filled two-electrode impulse switch tubes (trigger tubes) reproduced from American types were delivered in 1951; these made a good impression.

36. Highly resistant carbon resistors, which at first were a great bottleneck, were available in greater quantities from 1950 on. The reproduction of the SAF selenium rectifier was partly good, partly bad.

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37. The reproduction of a twin-engine Douglas aircraft made a good impression. In repairing the electric altimeter of this aircraft, [redacted] it was an exact reproduction of the American apparatus working with 50-centimeter waves. The wiring and the quality of the parts were good. Only the repair service seemed to present difficulties to the Soviets.

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[redacted] Comment: According to available information, there is both an NII 88 and a Zavod 88 located in Mytishchi/Podlipki, near Kaliningrad. Professor Yuriy Aleksandrovich Pobedonostsev has been previously reported as being either the director or technical director of NII-88 and Maj. Gen. Lev Robertovich Gonor has been reported as either the director of Zavod 88 or the director of NII-88. Both NII-88 and Zavod 88 are known to be subordinate to the Ministry for Armaments under minister D.F. Ustinov. [redacted]

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Attachments:

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2. Layout sketch of Zavod 88.

3. Location and layout sketch of Branch No. 1 of Zavod 88 on Gorodomlya Island.

4. Sketch of the trajectory model.

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Soviet Administrative Personnel

Ministry for Armaments

Ustinov, D. F.	Minister.
Ilyushin (fnu)	Deputy Minister.
Gaydukov (fnu)	General, was in Bleicherode.
Rubinovich (fnu)	Researcher on high-frequency matters, good technician.

Zavod 88

Gonor, Lev Robertovich	Maj. General, director of Zavod 88, was released in 1950.
Rudnov (fnu)	Successor of Maj. General Gonor.
Matveyev (fnu)	Deputy of Maj. General Gonor.
Pobedonostsev, Yuriy Aleksandrovich	Professor, chief engineer from 1948 to 1950; later presumably turned to scientific work. Holder of the Stalin Prize, presumably for the "Stalin Organ".
Korolov (fnu)	Works on propulsion matters, presumably also on the Wasserfall AA rocket. Was in Ostashkov several times; speaks English well.
✓ Chertok (fnu)	Lieutenant colonel. In charge of the servo-control department until 1950. Was in Bleicherode.
Stepan (fnu)	Deputy to Chertok; was in Bleicherode.
Rashkov (fnu)	Lieutenant colonel. Worked on small AA rockets (Rheintochter and Schmetterling) in Berlin after the war, and on the Schmetterling rocket in Zavod 88. Probably went to Bolshevo later.

Attachment 1

Filippov (fnu)	Worked in the control department on airborne wiring problems. Was in Zavod 88 until 1949.
Romanov (fnu)	Probably worked on the trajectory model. Was at Zavod 88 until 1952.
Bubermann (fnu)	Collaborator on the trajectory model.
Tolstousov (fnu)	Collaborator on controls or the trajectory model.
Markov (fnu)	Collaborator in the gyroscope laboratory.
Aigvertin (fnu)	Low-frequency laboratory.
Rosemann (fnu)	Worker on AA rockets. Later went to the Ministry for Armaments.
Sergeyev (fnu)	Director of the radio group; was with the Gema in Berlin. Presumably was the successor of Chertok.
Kardash (fnu)	Collaborator in the radio group.
Chernopyatov (fnu)	Radio group, later in Ostashkov.
Gruzinov (fnu)	Worker on the Messina apparatus; certainly at the factory until 1947.
Bugayev (fnu)	Director of a high-frequency laboratory; was released in October 1949. Later worked in Zagorsk on propulsion matters. Was formerly in an official post for overseas radio.
Cherbakova (fnu)	Director of a high-frequency laboratory,
Fratkina (fnu)	Collaborator in the testing laboratory.
Yarova, Vera	Collaborator in the testing laboratory.
Umanskiy (fnu)	Lieutenant colonel, in charge of the combustion chamber testing stand.
Rapoport (fnu)	In the administration; went to the Ministry for Armaments in 1948.

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[redacted] Attachment 1

Krasnoshukin (fnu), Professor Krayushkin (fnu)	Both scientists, very good theoreticians in the field of control. Belonged either to Zavod 88 or to high official posts.
Konoplov (fnu)	Technician for control matters. Came several times from Leningrad, where he presumably was in charge of a group for radio controls.
Solovyev (fnu)	Director of the First Department of Zavod 88.
Solovyev (fnu)	Was assigned to Zavod 88 by the Ministry for Foreign Manpower (sic)[1] as chief of the guard service.

Branch No. 1 of Zavod 88 on Gorodomlya Island

Branch director

Agafonov (fnu)	Director until fall 1947.
25X1 Sukhomlinov, Fedor Yuliyevich	[redacted] director since fall 1947. A 24-year-old son of his was with the Soviet diplomatic mission in Bulgaria.

Chief engineer

25X1 Bosh-Kotsyubinskiy (fnu)	[redacted] chief engineer from October 1946 until 1 May 1947. Left because of differences with the leaders of the statistics group.
25X1 Kurganov (fnu) 25X1	[redacted] Went to the Ministry for Armaments.
25X1 Kiselov (fnu)	[redacted] special chief engineer from 1 May 1949 to 1 May 1950.
25X1 Vasilyev, Leonid Pavlovich	[redacted] Chief engineer from 1 May 1950; was formerly deputy director of Sector 4.

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Trade Union

Panova (fnu)	1951.

Welfare Office

Shurik (fnu)	Chief of the office until 1950.
Klimenkov (fnu)	Chief of the office since 1950.

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Smirnov (fnu), as well as two additional assistants and a female interpreter.

Clinic

Mrs Kiselova (fnu)

Mrs Vasilyeva (fnu)

Group Which Arrived in May 1951 to Take Over the Radio Control Equipment Developed in Sector 4

Director

25X1 25X1 25X1 25X1	Fomin (fnu)	High-frequency engineer, [redacted] good technician. Worked a short time together with Rashkov in a laboratory of Zavod 88 on the development of the Schmetterling rocket.
25X1 25X1	Brutnov, Natan	High-frequency engineer, [redacted] standard knowledge.
25X1	Yuryev, Naum	High-frequency engineer [redacted] theoretician.
	Matveyev (fnu)	Mechanic.

[redacted]

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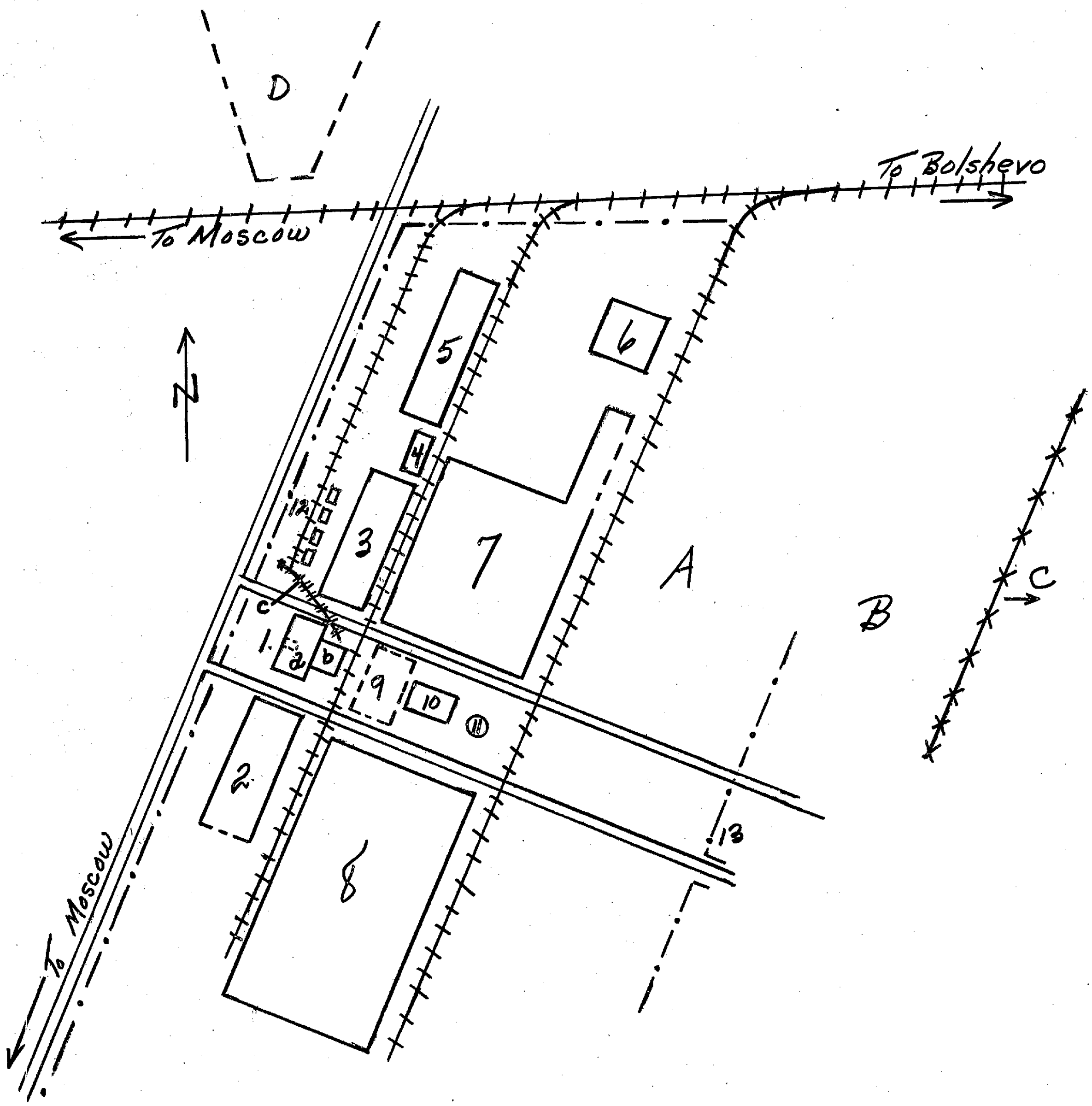
Attachment 2

Layout Sketch of Zavod 88



Scale: about 1:5,000

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Legend for Attachment No. 2

A. Zavod 88.

1. Main building.

   a) Two-story section. First floor: library, book-keeping office, cashier's office, telephone exchange. Second floor: working space for the director, chief engineer, and the First Department, as well as a large conference room.

   b) Four-story section. Laboratories on all four floors and in the basement.

   c) Circuits for the radar train.

2. Building. In the north section of the second floor are the design offices [redacted] On the first floor, among other things, there is a lathe shop, a milling shop, and a precision testing laboratory with numerous American instruments.

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3. Shed with cupola furnaces and foundry.

4. Presumably a step-down transformer station.

5. Shed with heavy steam hammers.

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6. Newly built shed, brick construction, about 20-25 meters high, the highest building in the factory. Heavy beams were mounted under the roof. The roof construction would not have required such heavy beams. The shed [redacted] was completed in February 1949.

7. Shed.

8. Shed.

9. Garden nursery.

10. Boiler house.

11. Water tower.

12. Siding onto which the radar train was switched.

13. Main gate.

B. Power plant.

C. To a heating plant.

D. Newly built housing units.

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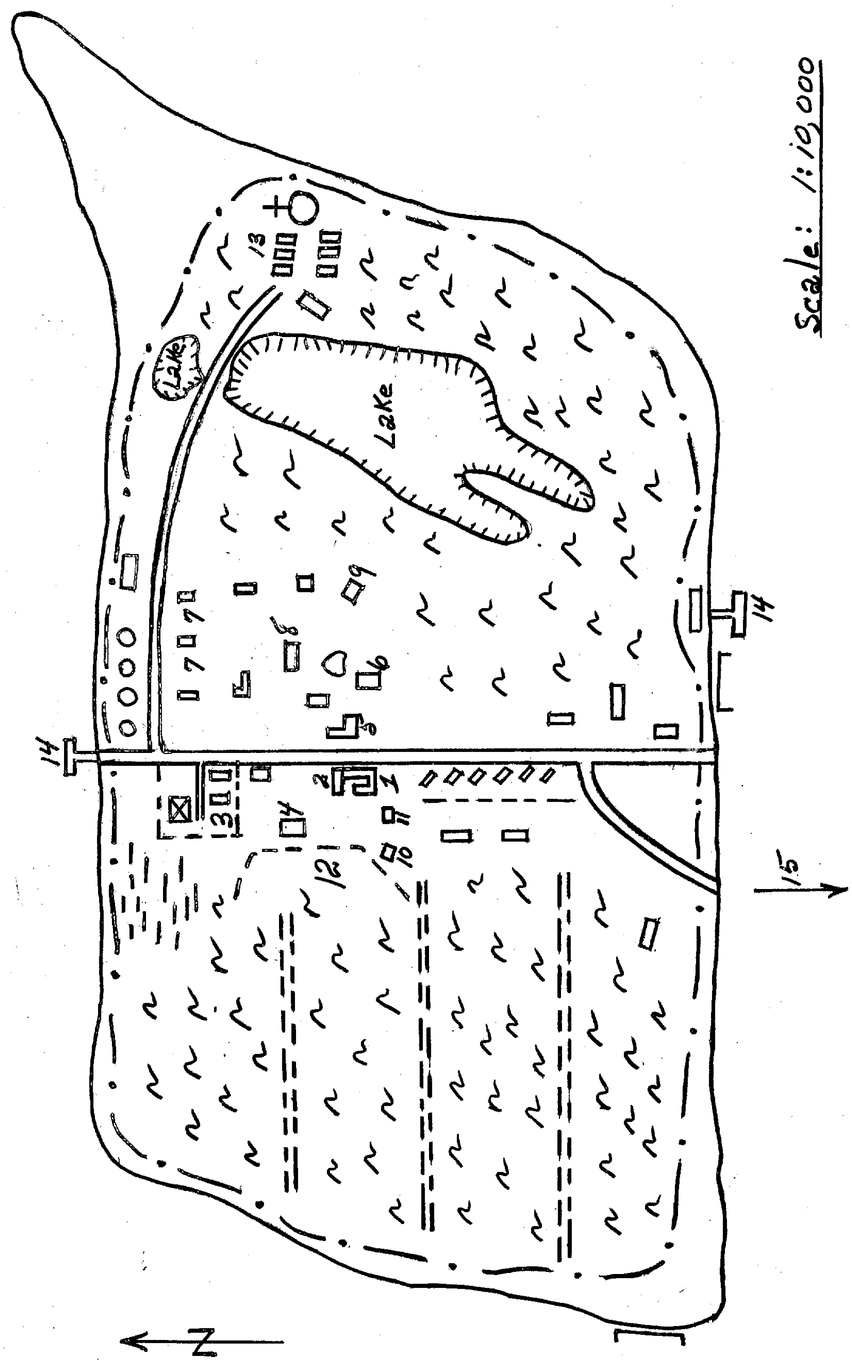
[redacted]

Attachment 3

Location and Layout Sketch of Branch No. 1 of Zavod No. 88 on Gorodomlya Island



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Legend to Attachment 3

1. Institute.
2. Institute work shop.
3. Combustion chamber laboratory with combustion test stand.
4. Carpentry shop.
5. Shops.
6. Electric power plant.
7. Living quarters.
8. Canteen.
9. Water pump.
10. Clinic.
11. Kindergarten.
12. Square.
13. Small village.
14. Landing places.
15. Winter route across the ice to Ostashkov.

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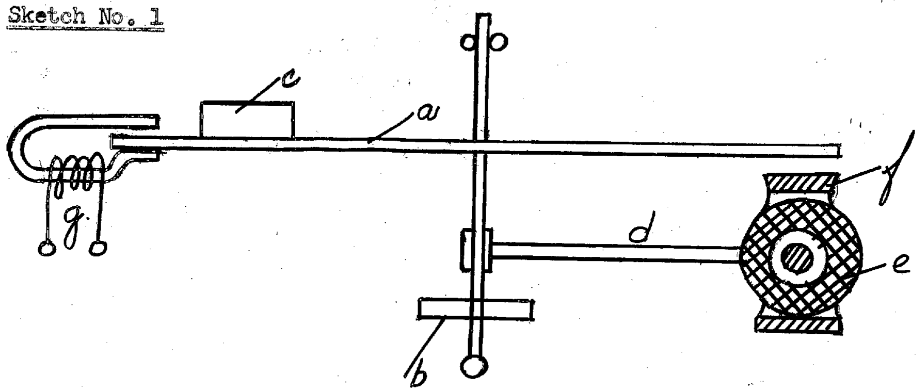
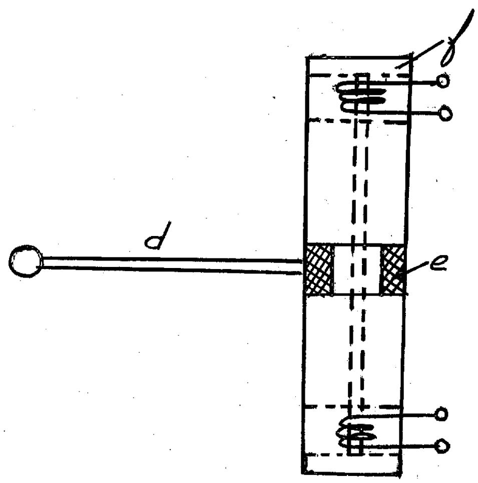
Attachment 4

Sketch of Trajectory Model

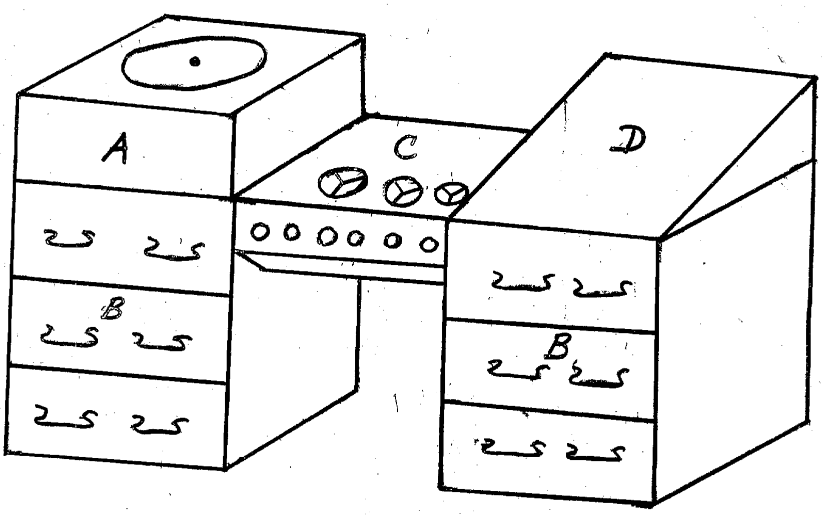
Sketch No. 1





Not to scale

Sketch No. 2



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Attachment 4

Description of the Trajectory Model

1. The trajectory model made it possible to investigate the characteristics of a control apparatus in the laboratory. The following angular ballistic variables were represented in the trajectory model:

   a. The control signal transmitted by radio and the inherent stabilization produced by the gyroscope.

   b. The vane angle.

   c. The axis angle.

   d. The direction of flight.

   e. The DF bearing (from the ground station).

   f. The control signal determined on the ground, which again affects a).

   The dependence of each of these magnitudes on the preceding was represented by mathematical formulas, which were solved by the trajectory model.

2. The most important components of the trajectory model were the integration devices (Diagram 1). The desired integral was represented by the angle of torsion of a very well mounted disk (a) of about 40 centimeters diameter. The tap of a Fliegenbein potentiometer (b) was simulated by the torsion. The moment of inertia of the disk could be changed by additionally included masses (c). A moment of rotation proportional to the integrating magnitudes affected this disk by means of an electrodynamic drive. The drive consisted of a spool (e) resting on an arm (d); this spool was able to move in an electromagnet (f). One pole of this electromagnet was formed by an iron rod passed through the spool; the other, by two iron plates. A variable brake power (g) was attached to the edge of the disk by means of an electromagnetic eddy-current brake. All the integration devices were arranged together in a section of the trajectory model about 60-70 by 60-70 by 50 centimeters in dimensions (A of Diagram 2).

3. The voltage measured by the potentiometer of an integration device, after amplification, was delivered through a so-called "coefficient indicator" to the drive of the next integration stage. The influence of all fixed and chronologically variable characteristic values of the rocket was allowed for in the coefficient indicator. Chronologically variable magnitudes were represented by cam disks. The amplifiers were at first direct current and later alternating current amplifiers.

4. The trajectory model was in the shape of a desk (Diagram 2). The control apparatus to be tested could be placed on a rotary disk of Part A. The insertions (B) contained the coefficient indicators. The necessary instruments and forward buttons for setting the coefficients were attached to the plate of Part C. Part D contained an oscillograph and a connection for the attachment of a loop oscillograph.

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